SOCIAL PHARMACY PRACTICAL

Immunization schedule for infants and children

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1. Aim: To study and understand the immunization schedule for infants and children.

2. Theory / Principle :

1. Vaccine and its types Part- I
2. Immunity and its types Part- II
3. Immunization
4. What is UIP? Part – III

3) **Procedure / Experiment :** Part- IV

1. To understand the immunization schedule for Infants.
2. To understand the immunization schedule for Children.

4) **Result :**

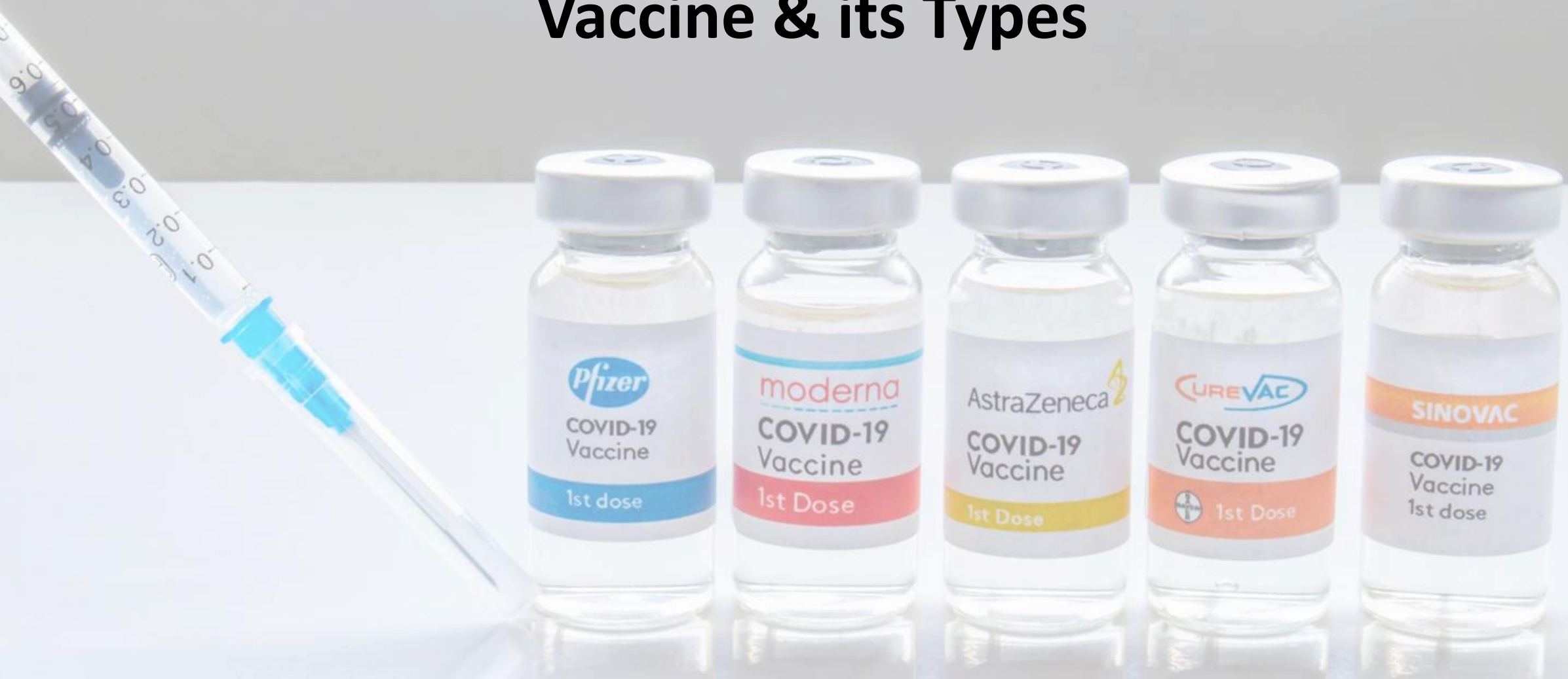
5) **Synopsis / VIVA questions:** Part- IV

6) MCQ's :

- Vaccine and its types

- Part- I

Vaccine & its Types



Vaccine

Defination: “A substance used to stimulate the production of antibodies and provide immunity against one or several diseases, prepared from the causative agent of a disease, its products, or a synthetic substitute, treated to act as an antigen without inducing the disease”.

OR

A preparation that is used to stimulate the body's immune response against diseases.

Vaccines are made from microbes that are dead or inactive so that they are unable to cause disease. The antigen in the vaccine is the same as the antigen on the surface of the disease-causing microbe. The vaccine stimulates the body to **produce antibodies against the antigen in the vaccine.** The antibodies created will be the same as those produced if the person was exposed to the pathogen. If the vaccinated person then comes into contact with the disease-causing microbe, the immune system remembers the antibodies it made to the vaccine and can make them faster. The person is said to be immune to the pathogen.

They can be prophylactic as well as therapeutic

- **Composition of Vaccines:**

- In addition to the bulk antigen which is the main component of vaccines, vaccines are formulated by mixing with other fluids like water or saline, **additives or preservatives**, and sometimes **adjuvants.** Collectively, these additional ingredients are known as **excipients**.

- They ensure the quality and potency of the vaccine over its shelf life.

- Vaccines are usually formulated as liquids, but may be freeze-dried (lyophilized) for reconstitution immediately prior to the time of injection.

- **Preservatives** ensure the sterility of the vaccines over the period of its shelf life. They may be used to prevent contamination of multi-dose containers. In some cases, preservatives may be added during manufacture to prevent microbial contamination.

Types of Vaccine

There are several types of vaccines, including

- Inactivated vaccines.
- Live-attenuated vaccines.
- Messenger RNA (mRNA) vaccines.
- Subunit, recombinant, polysaccharide, and conjugate vaccines.
- Toxoid vaccines.
- Viral vector vaccines.

Inactivated Vaccines

- It is a vaccine consisting of virus particles, bacteria, or other pathogens that have been grown in culture and then killed to destroy disease-producing capacity.
- Pathogens for inactivated vaccines are grown under controlled conditions and are killed as a means to reduce infectivity and thus prevent infection from the vaccine.
- Inactivated vaccines were first developed in the late 1800s and early 1900s for cholera, plague, and typhoid.
- Today, inactivated vaccines exist for many pathogens, including influenza, polio (IPV), rabies, hepatitis A and pertussis.

Inactivated Vaccines

- Because inactivated pathogens tend to produce a weaker response by the immune system than live pathogens, immunologic adjuvants and multiple "booster" injections may be required in some vaccines to provide an effective immune response against the pathogen.
- Whole pathogen inactivated vaccines are produced when an entire pathogen is 'killed' using heat, chemicals, or radiation, although only formaldehyde and beta-Propiolactone exposure are widely used in human vaccines.

Live-attenuated vaccines

- These vaccines use pathogens that are still alive (but are almost always attenuated, that is, weakened).

- Attenuated vaccines are often preferable for generally healthy people because a single dose is often safe and very effective. However, some people cannot take attenuated vaccines because the pathogen poses too much risk for them (for example, elderly people or people with immunodeficiency).

Example: measles , Mumps, Rubella

Attenuated : reduced in value/ effect.

Messenger RNA (mRNA) vaccines

- Most vaccines contain a weakened or dead bacteria or virus. However, scientists have developed a new type of vaccine that uses a molecule called messenger RNA (or mRNA for short) rather than part of an actual bacteria or virus. Messenger RNA is a type of RNA that is necessary for protein production.

- In cells, mRNA uses the information in genes to create a blueprint for making proteins. Once cells finish making a protein, they quickly break down the mRNA. mRNA from vaccines does not enter the nucleus and does not alter DNA.

Messenger RNA (mRNA) vaccines

- mRNA vaccines work by introducing a piece of mRNA that corresponds to a viral protein, usually a small piece of a protein found on the virus's outer membrane. (Individuals who get an mRNA vaccine are not exposed to the virus, nor can they become infected by the vaccine.) Using this mRNA blueprint, cells produce the viral protein. As part of a normal immune response, the immune system recognizes that the protein is foreign and produces specialized proteins called antibodies.
- Antibodies help protect the body against infection by recognizing individual viruses or other pathogens, attaching to them, and marking the pathogens for destruction. Once produced, antibodies remain in the body, even after the body has rid itself of the pathogen, so that the immune system can quickly respond if exposed again. If a person is exposed to a virus after receiving mRNA vaccination for it, antibodies can quickly recognize it, attach to it, and mark it for destruction before it can cause serious illness.

Subunit, recombinant, polysaccharide, and conjugate vaccines.

- Subunit, recombinant, polysaccharide, and conjugate vaccines use specific pieces of the germ—like its protein, sugar, or capsid (a casing around the germ). Because these vaccines use only specific pieces of the germ, they give a very strong immune response that's targeted to key parts of the germ.
- Immune response
- Subunit vaccines, like inactivated whole-cell vaccines, do not contain live components of the pathogen. They differ from inactivated whole-cell vaccines, by containing only the antigenic parts of the pathogen. These parts are necessary to elicit a protective immune response.
- This precision comes at a cost, as antigenic properties of the various potential subunits of a pathogen must be examined in detail to determine which particular combinations will produce an effective immune response within the correct pathway.
- Often a response can be elicited, but there is no guarantee that immunological memory will be formed in the correct manner.
- Safety and stability
- Like inactivated vaccines, subunit vaccines do not contain live components and are considered as very safe.

Example: Hib , Pneumococcal, meningococcal

Toxoid vaccines

- Toxoid vaccines are based on the toxin produced by certain bacteria (e.g. tetanus or diphtheria).
- The toxin invades the bloodstream and is largely responsible for the symptoms of the disease. The protein-based toxin is rendered harmless (toxoid) and used as the antigen in the vaccine to elicit immunity.
- To increase the immune response, the toxoid is adsorbed to aluminum or calcium salts, which serve as adjuvants.

Toxoid vaccines

- Toxoid vaccines are safe because they cannot cause the disease they prevent and there is no possibility of reversion to virulence.

- The vaccine antigens are not actively multiplying and do not spread to unimmunized individuals. They are stable, as they are less susceptible to changes in temperature, humidity and light.

Viral vector vaccines

- Viral vector-based vaccines differ from most conventional vaccines in that they don't actually contain antigens, but rather use the body's own cells to produce them.
- They do this by using a modified virus (the vector) to deliver genetic code for antigen, in the case of COVID-19 spike proteins found on the surface of the virus, into human cells.
- By infecting cells and instructing them to make large amounts of antigen, which then trigger an immune response, the vaccine mimics what happens during natural infection with certain pathogens - especially viruses.
- This has the advantage of triggering a strong cellular immune response by T cells as well the production of antibodies by B cells.
- An example of a viral vector vaccine is the rVSV-ZEBOV vaccine against Ebola.

Sr. No.	Vaccine-preventable Disease	Type of Disease	Type of Vaccine
1.	Measles	Viral	Live attenuated
2.	Mumps	Viral	Inactivated; live attenuated
3.	Rubella	Viral	Live attenuated
4.	Varicella (Chicken pox)	Viral	Live attenuated
5.	Herpes Zoster	Viral	Live attenuated
6.	Rota virus	Viral	Live attenuated
7.	Japanese encephalitis	Viral	Inactivated; live attenuated
8.	Tick-borne encephalitis	Viral	Inactivated
9.	Hepatitis A	Viral	Inactivated
10.	Meningococcal	Bacterial	Polysaccharide; protein conjugate
11.	Haemophilus influenza type b	Bacterial	Polysaccharide; protein conjugate
12.	Hepatitis B	Viral	Plasma derived; recombinant protein
13.	Anthrax	Bacterial	Protein
14.	Human Papilloma virus	Viral	Recombinant protein
15.	Small pox	Viral	Live attenuated
16.	Rabies	Viral	Inactivated
17.	Typhoid	Bacterial	Inactivated; live attenuated; polysaccharide; protein conjugate
18.	Cholera	Bacterial	Inactivated (injectable); inactivated and recombinant (oral); inactivated (oral)
19.	Plague	Bacterial	Inactivated
20.	Diphtheria	Bacterial	Toxoid
21.	Tetanus	Bacterial	Toxoid
22.	Pertussis	Bacterial	Inactivated; purified protein
23.	Tuberculosis	Bacterial	Live attenuated
24.	Yellow fever	Viral	Live attenuated
25.	Influenza	Viral	Inactivated; live attenuated
26.	Polio	Viral	Inactivated; live attenuated
27.	Pneumococcal	Bacterial	23-valent polysaccharide; protein conjugate

Note: In the last column ... over the time.

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Immunity and its types

Part- II

Immunity

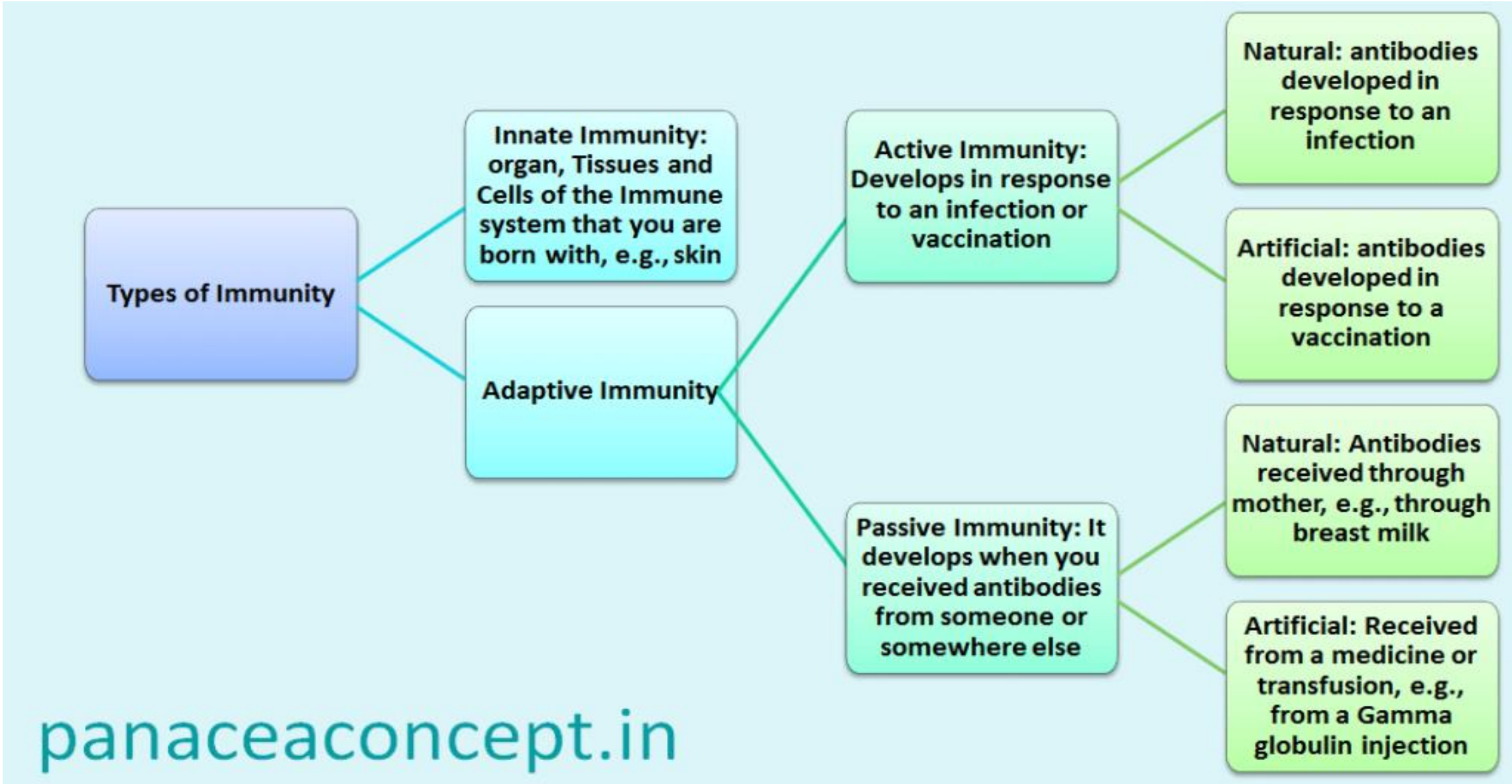
- **Immunity:**
- Immunity is defined as “ability to produce and possess specific protective antibodies or the cellular mechanism, as a result of previous infection or immunization or body condition so by such previous experience as to respond sufficiently to prevent infection or clinical illness or both, after exposure to a specific infectious agent”.

OR

- The power of the body to resist the effects of invasion of pathogens is known as immunity

Immunology:

- Immune + logy. It is the complete study of the immune (our body’s bodyguard) system which majorly includes antigen, antibody and their interactions, resulting in desirable or undesirable biological actions.


Types of Immunity
Innate Immunity: organ, Tissues and Cells of the Immune system that you are born with, e.g., skin
Adaptive Immunity
Active Immunity: Develops in response to an infection or vaccination
Natural: antibodies developed in response to an infection
Artificial: antibodies developed in response to a vaccination
Passive Immunity: It develops when you received antibodies from someone or somewhere else
Natural: Antibodies received through mother, e.g., through breast milk
Artificial: Received from a medicine or transfusion, e.g., from a Gamma globulin injection
panaceaconcept.in

- **Types of Immunity:**

1.Natural immunity / Innate :

- Species
- Age

- (Children of age 2-5 yrs. are susceptible to diphtheria whereas most adults are immune to it)
  - Racial (Negros possess high resistance to yellow fever than white man)
  - Individual
    (It depends on immune capacity of individual some are resistant or some are sensitive)

2. **Acquired immunity**

- Active
  - Natural / clinical / subclinical
  - Artificial
- Passive
  - Natural (congenital colostrum)
  - Artificial (antiserum, antitoxins)

1. **Active Immunity:**

- **A) Natural:**
- i) It is immunity developed after **infection or by specific immunization** and usually associated with presence of antibodies or cells with specific action on an infectious organism or its toxin.
- ii) It is developed after clinical or subclinical infection or following immunization and it is humoral or cellular type.

- **B) Artificial:**
- i) This is acquired by administration of **antigen usually by injection**. Example: vaccine either live or dead.
- Here antibodies i.e. immunoglobulins of 5 types are produced as IgG, IgM, IgE, IgD and IgA (Ig i.e. immunoglobulin). The antibodies work to destroy antigens. This is called humoral immunity.
- iv) The other type, cellular type active immunity works mainly against Mycobacterium, Salmonella, Candida and many viruses.
- v) It is long lasting, less expensive, with least side effects and characterized by memory mechanism; as compared to passive immunity.

- **2. Passive Immunity:**

- i) When antibodies produced in one body (human or animal) are transferred to another (formed in the **mother in response to disease and may be transferred to foetus through placental blood**) to induce protection against disease, it is called passive immunity.

- ii) Passive immunity is effective immediately as **ready-made antibodies are given to humans (**gamma globulins are immunoglobulins antibodies) by injecting the preparation known as antiserum. These are the antibodies produced in animals.

- iii) It is rapidly established, it is of very short duration, possesses no memory mechanism and may show side effects; there are some disadvantages.

3. **Herd Immunity: / community immunity/ population immunity/ social immunity.**

i) It is the level of immunity or resistance of a community or a group of people to a particular disease on background of past experience of a disease.

ii) Herd immunity develops in the community because of immunizations, infections and subclinical infections.

iii) The continuous or on-going immunization program can keep up the herd immunity at a very high level.

iv) It is a form of indirect protection from infectious disease that can occur with some diseases when a sufficient percentage of a population has become immune to an infection, whether through vaccination or previous infections, thereby reducing the likelihood of infection for individuals who lack immunity.

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Experiment – 1

Theory/ Principle

Part- III

- Theory:

- A national immunization programme (NIP) is the organizational component of Ministries of Health charged with preventing disease, disability, and death from vaccine-preventable diseases in children and adults.
- A NIP is a government programme that operates within the framework of overall health policy. Immunizations, also known as vaccinations, help to protect you from getting an infectious disease. When you get vaccinated, you help to protect others as well. Vaccines are very safe. It is much safer to get the vaccine than an infectious disease.

- Various immunization programmes for immunization have been evolved in the last few decades by the Ministry of Health and Family Welfare.

- 1. Expanded programme of immunization (EPI) was started in 1978 but only in urban areas.

- 2. The Universal Immunization Program (UIP) was started in 1985. During this program, the capacity for production of vaccines was increased, more districts were covered under the program and a cold chain was established at various places.

- 3. The Technology Mission on Immunization (TMI) was started in 1986. During the implementation, infants in the age group of 0 to 12 months were included.

- 4. Child Survival and Safe Motherhood (CSSM) was started in 1992 to include safe motherhood along with immunization.

- 5. The Reproductive Child Health (RCH) program was started in 1997 to make it more comprehensive.

- 6 National Rural Health Mission (NRHM), was started in 2005 to make the most comprehensive program to include all aspects of immunization to health of mother and child.

Sr. No	Immunization programme	Year	Purpose
1.	EPI	1978	immunization purpose
2.	UIP	1985	increase in vaccine production cold chain establishment Coverage provided to more districts than earlier.
3.	TMI	1986	infants (0- 12 months) were included
4.	CSSM	1992	Immunization and Safe motherhood
5.	RCH	1997	more comprehensive program
6.	NRHM	2005	Health of mother and child was more focused.

- The programme now consists of vaccination for 12 diseases-

1. Tuberculosis,
2. Diphtheria,
3. Pertussis (whooping cough).
4. Tetanus
5. Poliomyelitis
6. Measles
7. Hepatitis B
8. Diarrhoea
9. Japanese encephalitis
10. Rubella
11. Pneumonia (haemophilus influenzae type B) and
12. Pneumococcal diseases (pneumococcal pneumonia and meningitis).

- Under the Universal Immunization program, the following vaccines are being provided.
- 1 BCG (Bacillus Calmette Guerin)
- 2. DPT (Diphtheria, Pertussis and Tetanus toxoid)
- 3. OPV (Oral Polio Vaccine)
- 4. Measles
- 5. Hepatitis B
- 6. TT (Tetanus toxoid)
- 7. JEV (Japanese Encephalitis Vaccine, only in selected high burden districts)
- 8. Hib containing pentavalent Vaccine (DPTP + Hep B + Hib) (In selected states)

- Hepatitis B and Pneumococcal diseases were added to the UIP in 2007 and 2017 respectively.

- While for seven diseases mentioned in the above list, the immunization is county-wide, for Encephalitis and meningitis/Pneumonia it is available in selected districts with high disease burden.

- The purpose of the recommended immunization schedule is to protect infants and children by providing immunity early in life, before they are exposed to potentially life-threatening diseases.

The protection developed after vaccination usually lasts for many years and is able to stop the disease in most cases. Even if the child does get the disease after being vaccinated, the symptoms will be much milder than symptoms in a child who was never vaccinated.

For some vaccines, booster doses are given to children at specified ages to further raise the protection up to an optimum level.

- Vaccines ensure the best protection to children when they are given at the right age and in the required number of doses. At a certain period of life, there is a maximum incidence of a particular disease. Therefore, to prevent harm caused by the disease, booster vaccines are provided at that particular age.

- For example, the occurrence of Polio is maximum in children below 5 years of age; hence, vaccination against polio is given in routine immunization as well as in campaigns to children below 5 years of age Similarly, number of doses required is determined by the level of protection required to prevent serious infections.

- The National Immunization Schedule clearly mentions different vaccines, ages at which they are to be given, and doses required for ensuring full protection from vaccine-preventable diseases. All vaccines available in the country are licensed by Drug Controller General of India (DCGI) Therefore, are safe for use. However, complete immunization services are given to all the children and pregnant women free of cost, at the government health facilities.

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Experiment

Part- IV

NIP (Infants & Children)

- **Immunization:**

- Immunization is the process of protecting a large number of populations by producing immunity or resistance in the body by means of immunological agents (vaccines).

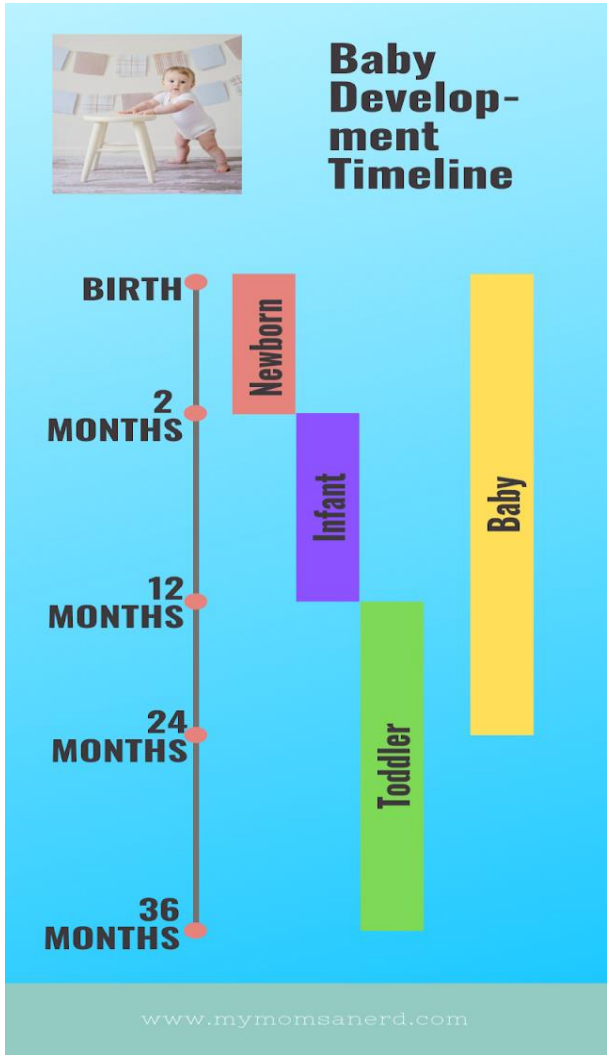
Or

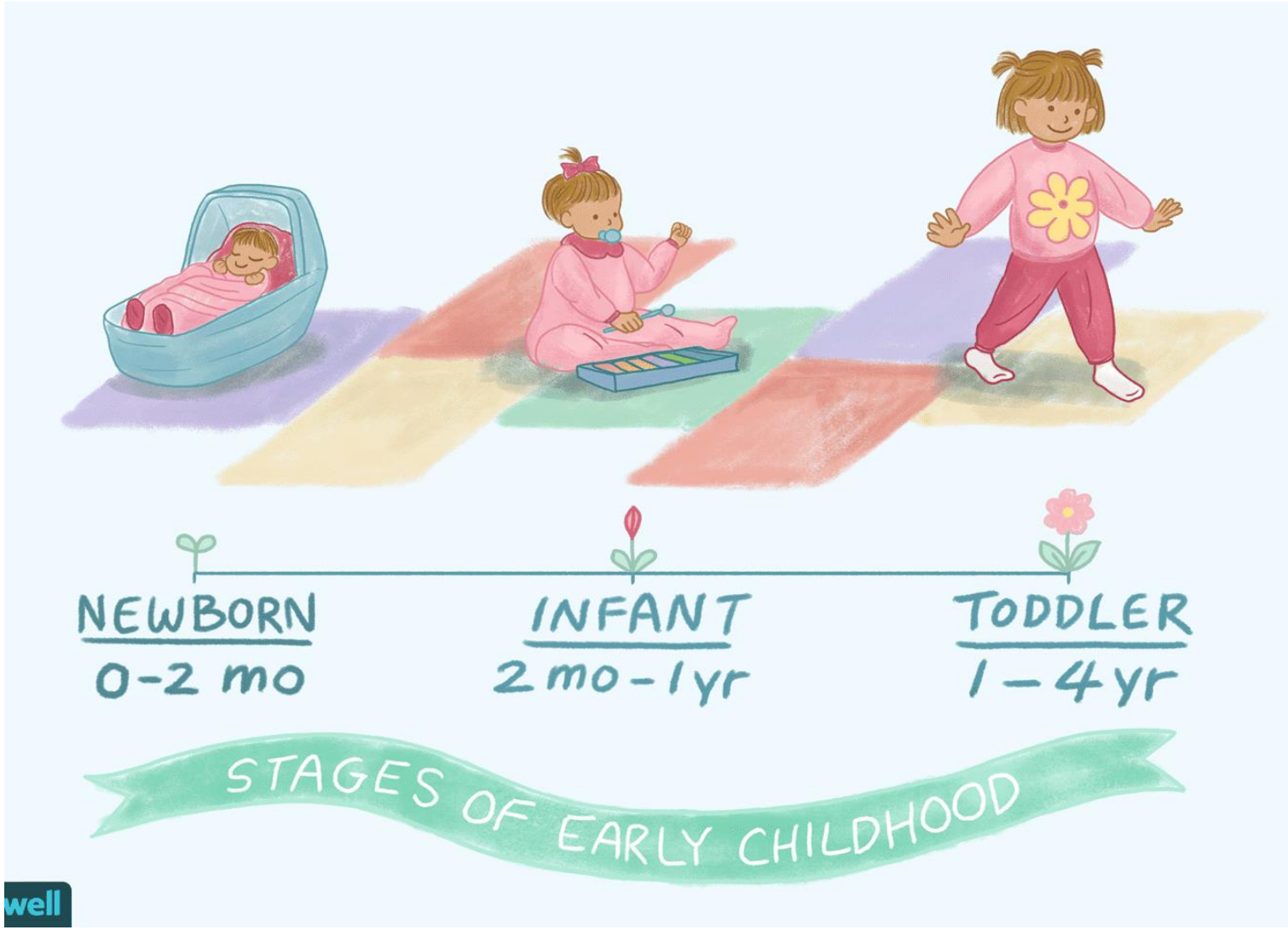
- It is defined as production of resistance in the body by means of immunological agents

- **National Immunization schedule:**

- Each country has its own immunization schedule based on their local needs. Indian schedule gives protection for children against six vaccine preventable diseases. i.e. Diphtheria, whooping cough, tetanus, polio, TB, measles.

National Immunization Schedule For Infants :





Vaccine and Disease Prevented	When to give	Maximum age	Dose	Route	Site
BCG (Bacillus Calmette Guerin) Childhood, Tuberculosis	At birth or as early as possible till 1 year of age	At birth till one year	0.1ml (0.05ml until 1 month age)	Intra- dermal	Left upper arm
Hepatitis B - Birth dose & Hebatitis B	At birth or as early as possible within 24 hours	At birth within 24 hours	0.5 ml	Intra-muscular	Antero-lateral side of mid-thigh
Oral Polio Vaccine (OPV) -0 & Poliomyelitis	At birth or as early as possible within first 15 days	Within the first 15 days	2 drops	Oral	Oral
Oral Polio Vaccine (OPV) -1,2,3, & Poliomyelitis	At 6 weeks, 10 weeks & 14 weeks	Till 5 years of age	2 drops	Oral	Oral
Inactivated Polio Vaccine (IPV) I & Poliomyelitis	At 6 weeks & 14 weeks	1 year of age	0.1 ml	Intra-dermal	Right Upper arm
Pentavalent vaccine (Diphteria, Pertussis, Tetanus, Hepatitis B, Haemophilus-influenzae type b) 1,2,3	At 6 weeks, 10 weeks & 14 weeks DTP- Hep-B- Hib	1 year of age	0.5 ml	Intra-muscular	Antero-lateral side of mid-thigh-right
Rotavirus Vaccine (RVV) 1, 2 & 3 & Rotavirus diarrhoea.	At 6 weeks, 10 weeks & 14 weeks	1 year of age	5 drops (lyophilized vaccine)	Oral	Oral

Pneumococcal Conjugate Vaccine (PCV) 1, 2 & Booster	At 6 weeks, 14 weeks & 9 months	1 year of age	0.5 ml	Intra-muscular	Antero-lateral side of mid-thigh
Measles-Rubella (MR) 1	9 completed months - to 12 months. Give up to 5yrs if not received at 9 - 12 months age	5 years of age	0.5 ml	Sub-cutaneous	Right upper arm
Vitamin A (1st dose)	At 9 completed months With measles	5 years of age	1ml (1lakh IU)	Oral	Oral
Japanese Encephalitis (1st Dose)***	At 9 completed months - 12 months	15 years of age	0.5 ml	Subcutaneous (live vaccine) Intramuscular (killed)	Left upper arm Antero-lateral side of mid thigh

National Immunization Schedule for Children

Vaccine	When to give	Dose	Route	Site	Disease prevented
DPT 1st booster	16-24 months	0.5ml	Intramuscular	Anterolateral sided mid thigh left	Diphtheria, pertussis & tetanus
OPV booster	16-24 months	2 drops	oral		Measles
Measles 2nd dose	16-24 months	0.5 ml	Subcutaneous	Right upper arm	Measles
Japanese Encephalitis Endemic (In selected districts only)	16-24 months	0.5 ml	Subcutaneous	Left upper arm	Japanese Encephalitis
Vitamin A (2nd to gth dose	16 months with DPT/OPV booster then one dose at every 6 months up to the age of 5 years	2ml (2 Lak biu)	Oral	-----	Prophylactic
DPT 2nd booster	5-6 years	0.5 ml	Intramuscular	Left upper arm	Diphtheria pertussis and tetanus
TT	10 years & 16 years	0.5 ml	Intramuscular	Upper arm	Tetanus

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Experiment

Part- V

Trick to remember NIP (Infants & Children)
Synopsis/ viva questions

- **Trick to remember :**

- When to give
- ROA
- Dose

When to give:

- **At birth:**

- 24 hrs ----- Hep – B
- 15 days ---- OPV- 0
- 1 yr / 24 months ---- BCG

- **6th, 10th, & 14th weeks**
- OPV – 1,2,3
- Pentavalent vaccine
- Rotavirus

6th & 14th week :

IPV.

09 -12 months :

Measles

1.5- 2 yrs / 16-24 months:

OPV booster, DPT, Measles, Japanese Encephalitis

10-16 yrs & pregnant women :

TT

ROA :

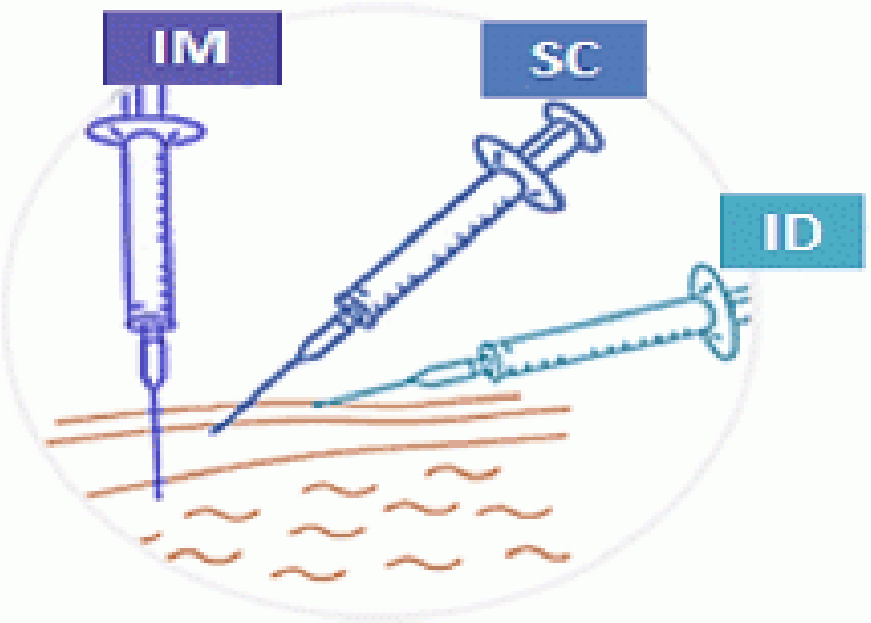
ORAL ------ OPV- 0, 1,2,3 Oral Polio Vaccine, Rotavirus, Vit- A

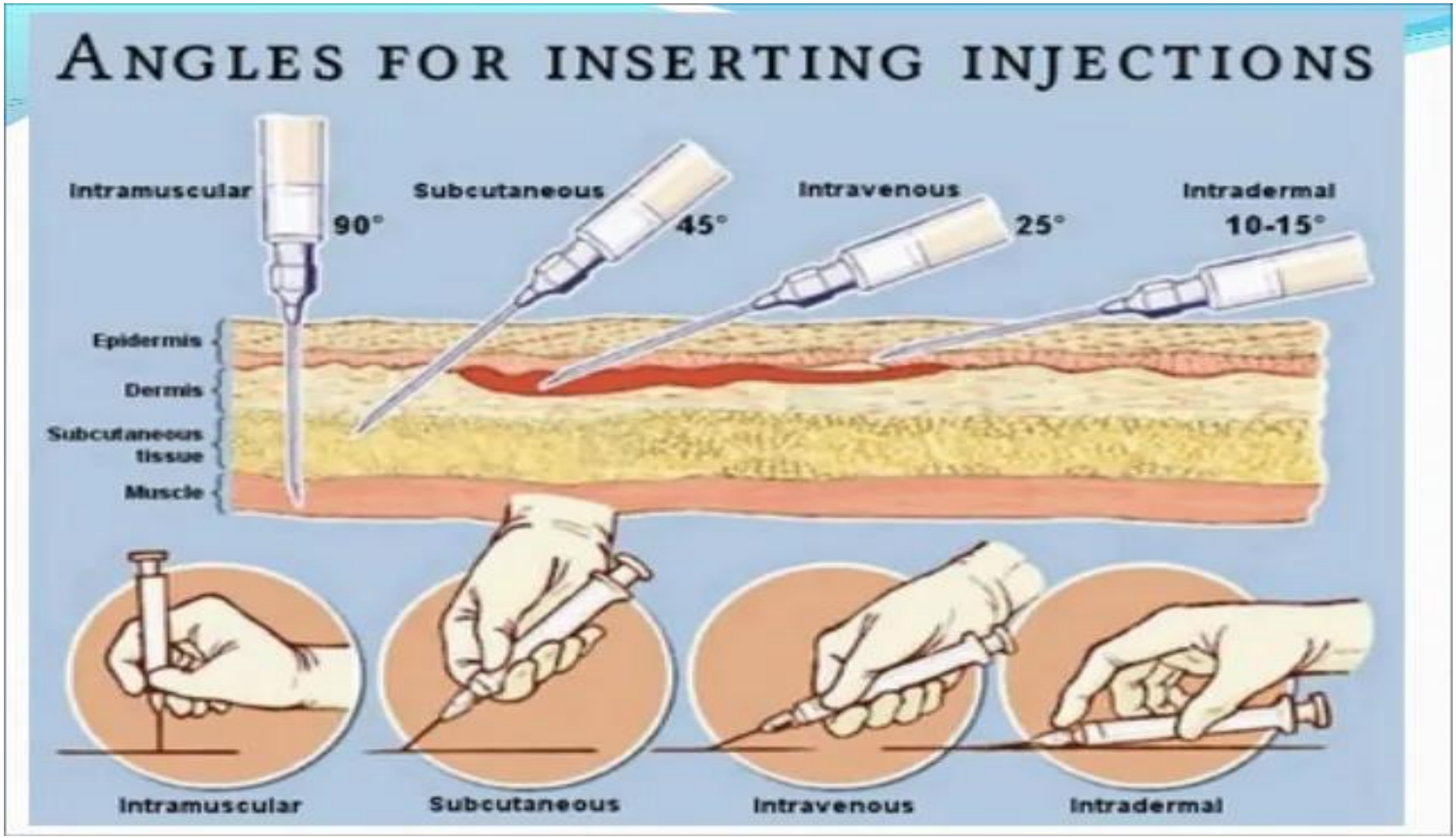
IM ------ **Pentavalent, Hepatitis- B,** Pneumococcal Conjugate Vaccine (PCV) , IPV, DPT, TT

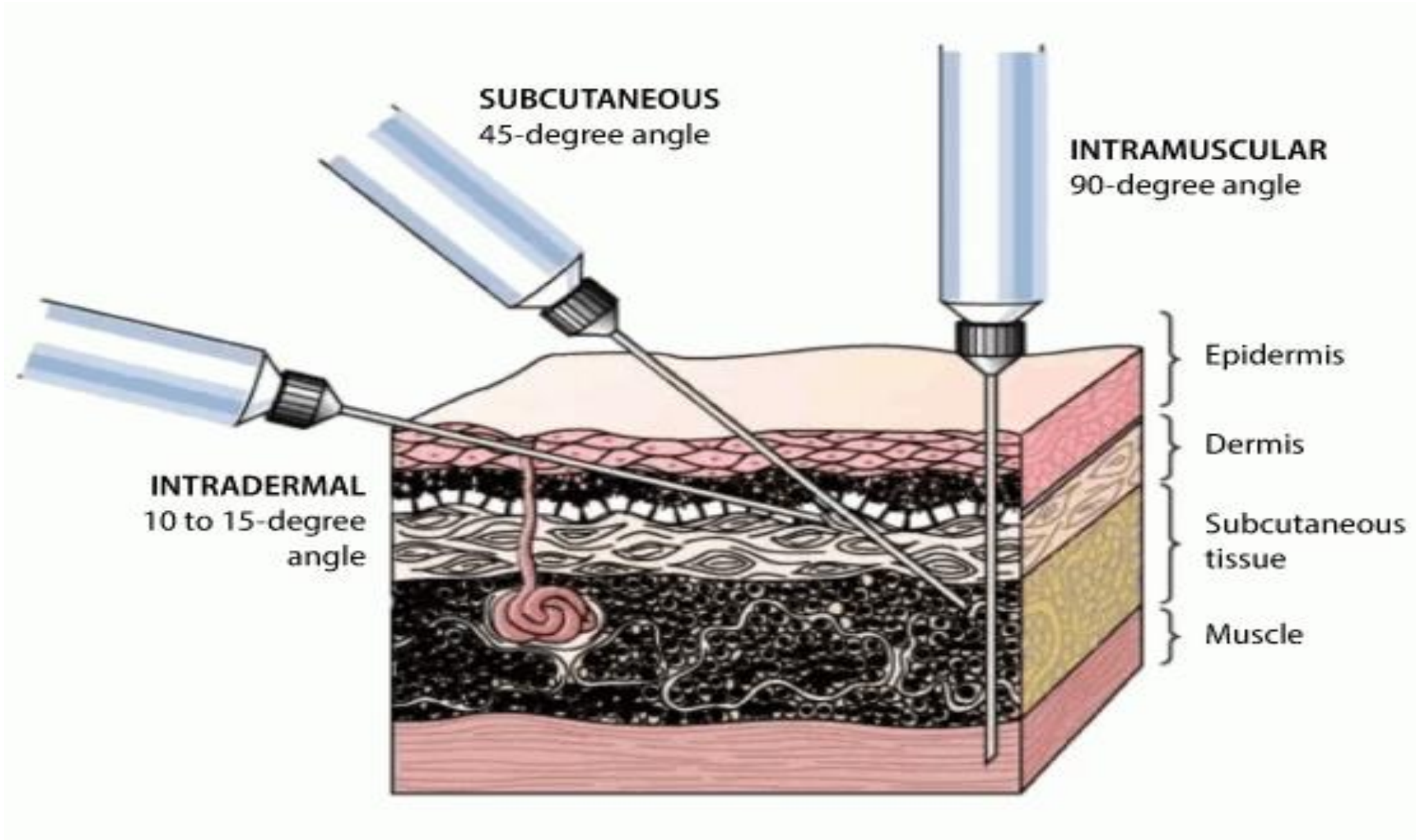
SC ------- Measles ------ (MSC) , JE

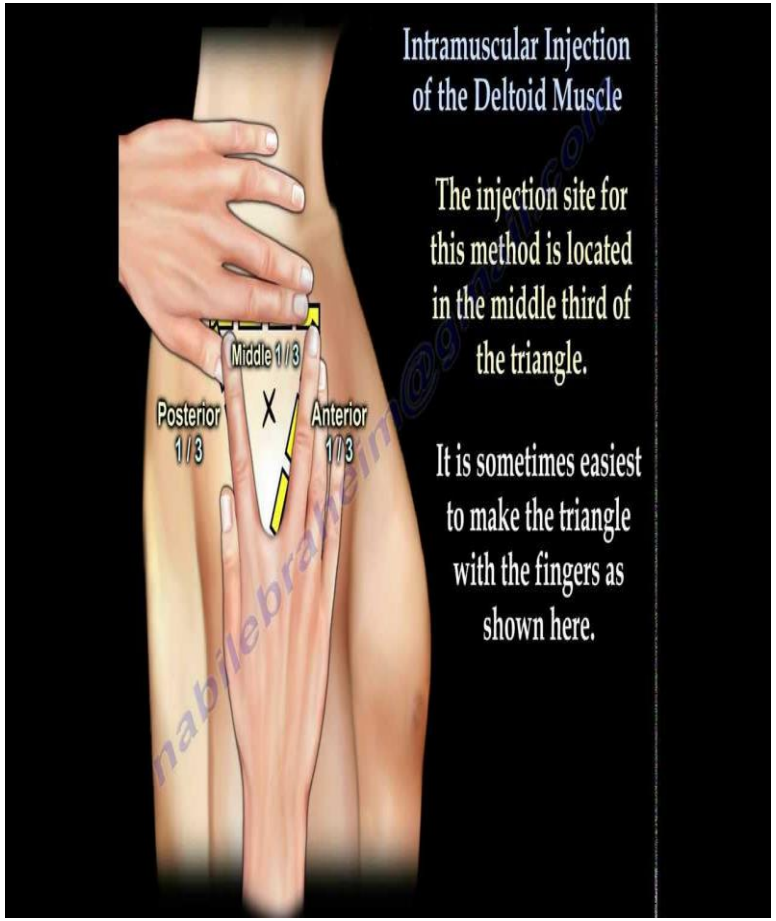
ID------ BCG (B----D) Bipasha

- **Oral**
  - OPV
  - Rotavirus
- **Intramuscular IM**
  - DTwP, DTaP, DT, Td, TT
  - Hepatitis A
  - Hepatitis B
  - IPV
  - HPV
  - Hib
  - PCV-7
  - Influenza
- **Subcutaneous SC**
  - Measles
  - Yellow fever
  - Varicella
- **Intradermal ID**
  - BCG

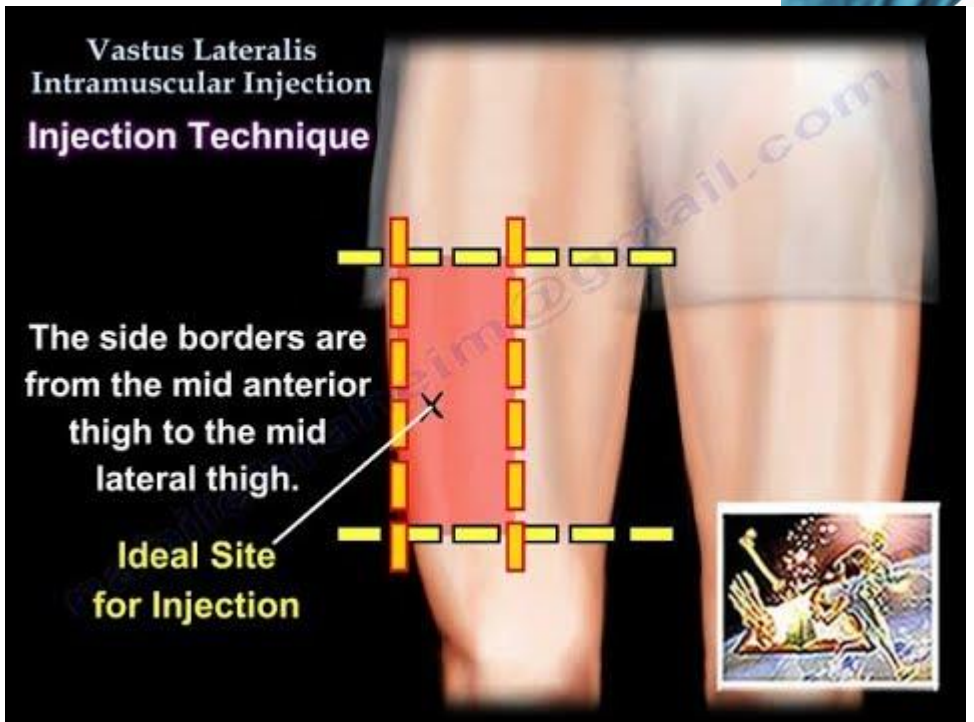



ANGLES FOR INSERTING INJECTIONS
Intramuscular
90°
Subcutaneous
45°
Intravenous
25°
Intradermal
10-15°
Epidermis
Dermis
Subcutaneous tissue
Muscle
Intramuscular
Subcutaneous
Intravenous
Intradermal


SUBCUTANEOUS
45-degree angle
INTRAMUSCULAR
90-degree angle
INTRADERMAL
10 to 15-degree
angle
Epidermis
Dermis
Subcutaneous
tissue
Muscle


Intramuscular Injection
of the Deltoid Muscle
The injection site for this method is located in the middle third of the triangle.
It is sometimes easiest to make the triangle with the fingers as shown here.
Middle 1/3
Posterior 1/3
Anterior 1/3

© AboutKidsHealth.ca


Vastus Lateralis
Intramuscular Injection
Injection Technique
The side borders are from the mid anterior thigh to the mid lateral thigh.
Ideal Site for Injection

Dose :

- 0.05/ 0.1 ml ----- BCG
- 0.5 ml ------- OPV-I (IPV), Pentavalent , DPT, TT, Measles, JE, Hep- B
- 1/ 2 ml ----- Vit- A (infants --- children)
- 2 drops ----- OPV- 0,1,2,3 (2 bund Jindagi ki)
- 5 drops ----- Rotavirus

- Result:

- The national immunization schedule is studied and understood.

Synopsis / Viva Questions:

1) Give the Route of administration for :

1. BCG (Bacillus Calmette Guerin)
2. DPT (Diphtheria, Pertussis and Tetanus toxoid)
3. OPV (Oral Polio Vaccine)
4. Measles
5. Hepatitis B
6. TT (Tetanus toxoid)
7. JEV (Japanese Encephalitis Vaccine, only in selected high burden districts)
8. Hib containing pentavalent Vaccine (DPTP + Hep B + Hib) (In selected states)

Q.2 Pentavalent vaccines covers which diseases
Q3. What is UIP?
Q.4. What is Pulse Polio Immunization?
Q5. What are vaccines?

Q.6. define: Immunization

Q.7. Explain the NIP for infants and children.

Q.8. Name the different routes of administration of vaccine.

Q.9. Write the dose for vaccines included in NIP.

Q.10 Explain immunity and its types.

Q.11. enumerate all the vaccines of NIP for the time when they are administered.

Q.12. Explain vaccine and its types.

Q.13. Match the following :

Sr.no	Name of vaccine	Dose/ Route/ disease/site of administration

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